MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

EEL1166 – CIRCUIT THEORY

(All sections / Groups)

16th OCT 2019
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of **FIVE** pages including cover page with **FOUR** questions only.

2. Answer **ALL** questions and print all your answers in the answer booklet provided.

3. All questions carry equal marks and the distribution of the marks for each question is given.

Question 1

(a) Using voltage divider rule and Ohm's law, calculate the voltage, V_{R4} in **Figure Q1(a)**. [6 marks]

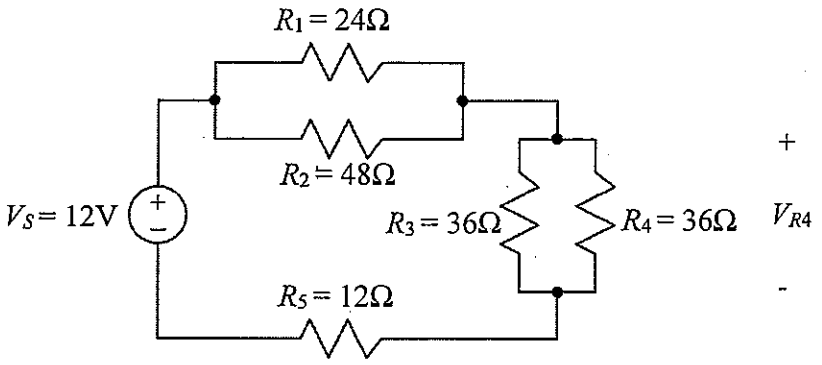
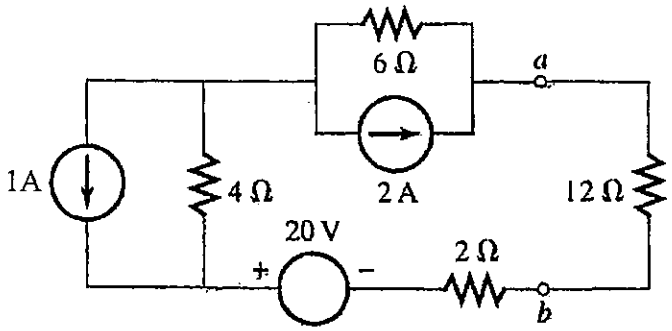


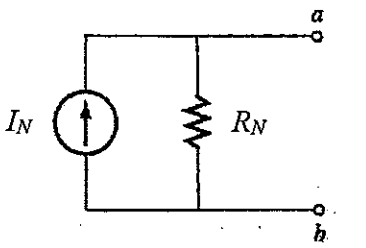
Figure Q1(a)

(b) What is the principle of superposition? [4 marks]

(c) A circuit with multiple voltage and current sources, and its Norton's equivalent circuit at nodes ***a-b*** are shown in **Figure Q1(c)(i) and Q1(c)(ii)** respectively. By applying both superposition principle and Norton's theorem, determine the Norton's current, I_N and Norton's resistance, R_N. [15 marks]
(*Note: Draw and show all the steps involved.*)



(i)



Norton's equivalent circuit

(ii)

Figure Q1(c)

Continued...

Question 2

(a) Consider the circuit shown in **Figure Q2(a)**.

(i) Redraw the circuit by transforming the voltage source into a current source. [4 marks]

(ii) Based on the circuit obtained in part(a)(i), form the nodal equations at node *A* and node *B*, and hence calculate the voltage, V_o by applying nodal analysis. [8 marks]

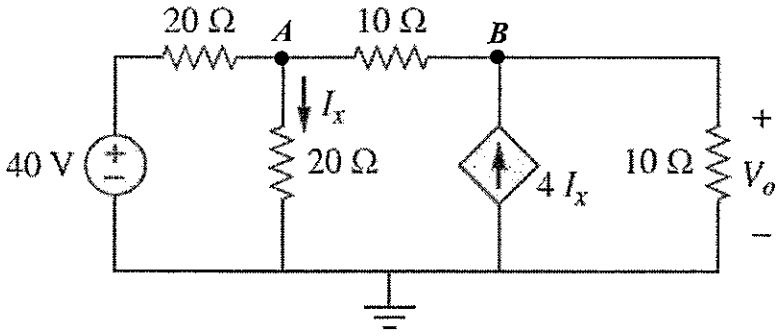


Figure Q2(a)

(b) Consider the circuit shown in **Figure Q2(b)**.

(i) Identify all meshes and essential nodes. [5 marks]

(ii) By applying supermesh on branch ***e-c***, determine the current, i_o using mesh analysis. [8 marks]

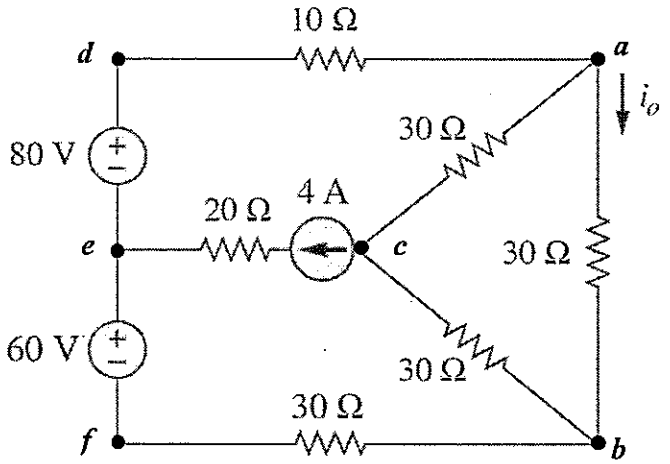


Figure Q2(b)

Continued...

Question 3

(a) For the alternating current (AC) circuit shown in **Figure Q3(a)**, calculate the followings:

(i) Total impedance. [5 marks]

(ii) Current, $i(t)$. [3 marks]

(iii) Voltage, $v(t)$. [3 marks]

(iv) Average power supplied by the voltage source. [3 marks]

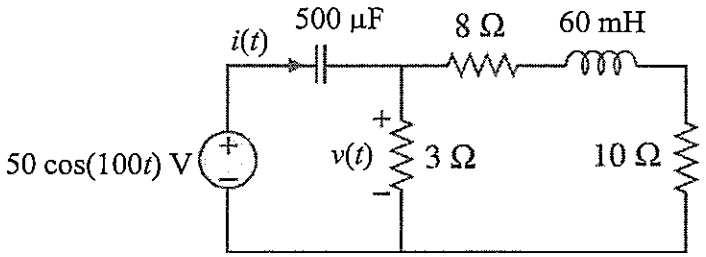


Figure Q3(a)

(b) Define the following terms with the relevant formulas:

(i) Resonant circuit. [2 marks]

(ii) Quality factor. [2 marks]

(c) A **series** RLC circuit consists of a resistance of 5Ω, an inductor of 8mH and a capacitor of 4μF.

(i) Find the resonant frequency. [2 marks]

(ii) Calculate the quality factor. [3 marks]

(iii) Determine the bandwidth. [2 marks]

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Question 4

(a) The switch of an RC circuit shown in **Figure Q4(a)** is closed at $t = 0$s.

(i) When does the transient behaviour occur in this circuit? Why? [4 marks]

(ii) When $t \geq 0$s, is the capacitor in its charging phase or discharging phase? [2 marks]

(iii) Derive the mathematical expression for the voltage across the capacitor, $v_c(t)$ when $t \geq 0$s. [7 marks]

(iv) Calculate the capacitor current, $i_c(t)$ at $t = 0.05$s. [3 marks]

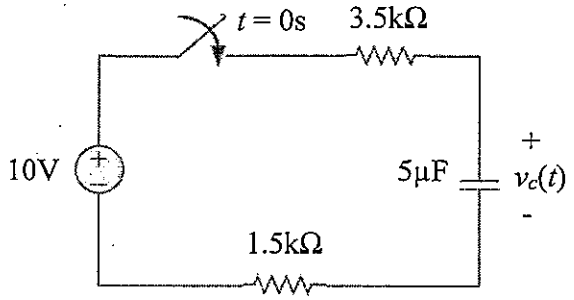

Figure Q4(a)

(b) A source free **parallel** RLC circuit has a characteristic equation given as:

$$s^2 + 0.5s + 100 = 0$$

(i) Draw the **parallel** RLC circuit. [2 marks]

(ii) Design the circuit by obtaining the values of inductor, L and capacitor, C if the resistor, $R = 1$kΩ. [4 marks]

(iii) Is the circuit having underdamped, overdamped or critically damped response? [3 marks]

End of Paper